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AN APPROACH TO COMPARING COSTS OF ELECTRONIC PROCESSING OF PERT DATA: PERT I VERSUS PERT III

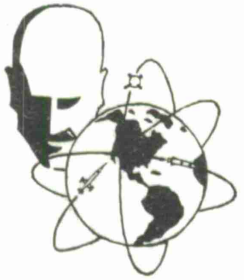
TECHNICAL DOCUMENTARY REPORT NO. ESD-TDR-64-113

JUNE 1964

A. E. Autio

Prepared for

COMPTROLLER
ELECTRONIC SYSTEMS DIVISION
AIR FORCE SYSTEMS COMMAND
UNITED STATES AIR FORCE
L. G. Hanscom Field, Bedford, Massachusetts



Project 850

Prepared by

THE MITRE CORPORATION
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Contract AF 19(628)-2390

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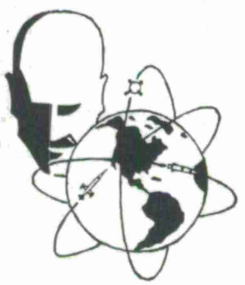

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SECTION V

SUMMARY

The cost of processing a single PERT network on the IBM 7090 computer can be estimated within reasonable bounds when the number of activities are known or can be estimated. For example, a 1000-activity network can be processed via the PERT I program for approximately $125. The same network can be processed via the PERT III program for approximately $75. These costs can be estimated with 95% confidence to be within a range of ± 25 percent on the PERT I program, and within a range of ± 50 percent on the PERT III program. (The latter estimates could be improved no doubt, with additional, more well-identified data.) The differences between the two programs are more striking above the 1200 activity threshold. If, say, 2000 activities need to be processed (assuming that extrapolations to this level are reasonably valid), this size network would cost approximately $340 via PERT I versus $120 on PERT III. The substantial improvement at this level is attributable to the increased capacity of the PERT III program.

In general, a cost-estimating relationship has been established via the IBM 7090 which, by itself, has rather limited utility. Comparison with like data from the 1410, Stretch or other computers might prove of value. Certainly of far greater value would be similar relationships for, say, military command and control systems.

A. E. Autio

AN APPROACH TO COMPARING COSTS OF ELECTRONIC PROCESSING OF PERT DATA: PERT I VERSUS PERT III

ABSTRACT

This document develops relationships for estimating costs of processing single runs of PERT data on the 7090 computer on the basis of the number of activities per network. A comparison is also made of the PERT I vs. PERT III processing costs in which the latter appears decidedly more attractive, particularly in the larger networks.

REVIEW AND APPROVAL

Publication of this technical documentary report does not constitute Air Force approval of the report's findings or conclusions. It is published only for the exchange and stimulation of ideas.

CHARLES R. BRUYR
Deputy Chief, Programs Division
Comptroller

AN APPROACH TO COMPARING COSTS OF ELECTRONIC PROCESSING OF PERT DATA: PERT I VERSUS PERT III

SECTION I

INTRODUCTION

The cost of processing a single run of PERT data on the 7090 computer is a function of the number of activities* contained in the network. A discontinuous straight-line function was fitted to a plot of elapsed times for single PERT runs versus the number of activities in the network (see Fig. 1). This function differs according to the computer program used. For example, the PERT III program, because of both its larger capacity and its more efficient program, is less costly to run for a given size network than is the PERT I program.

The processing cost can be read directly from the plot. The discontinuity in processing time (hence costs) is attributable to the fact that above a certain number of activities, the internal memory capacity of the machine is exceeded, and as external memory must be used, access time is increased. For the PERT I program, this threshold is purported to be at 1200 activities, which is confirmed to some extent by the data. For the PERT III program, the threshold is stipulated to be 6000** activities – though no experience has yet been gained at the

*The elapsed time in the computer is more causally related to activities than to events, in that (1) the card input is provided in terms of activities, and (2) the basic computations done by the machine are related to all possible activity paths and are independent of the number of events.

**AFSC PERT III Computer Handbook

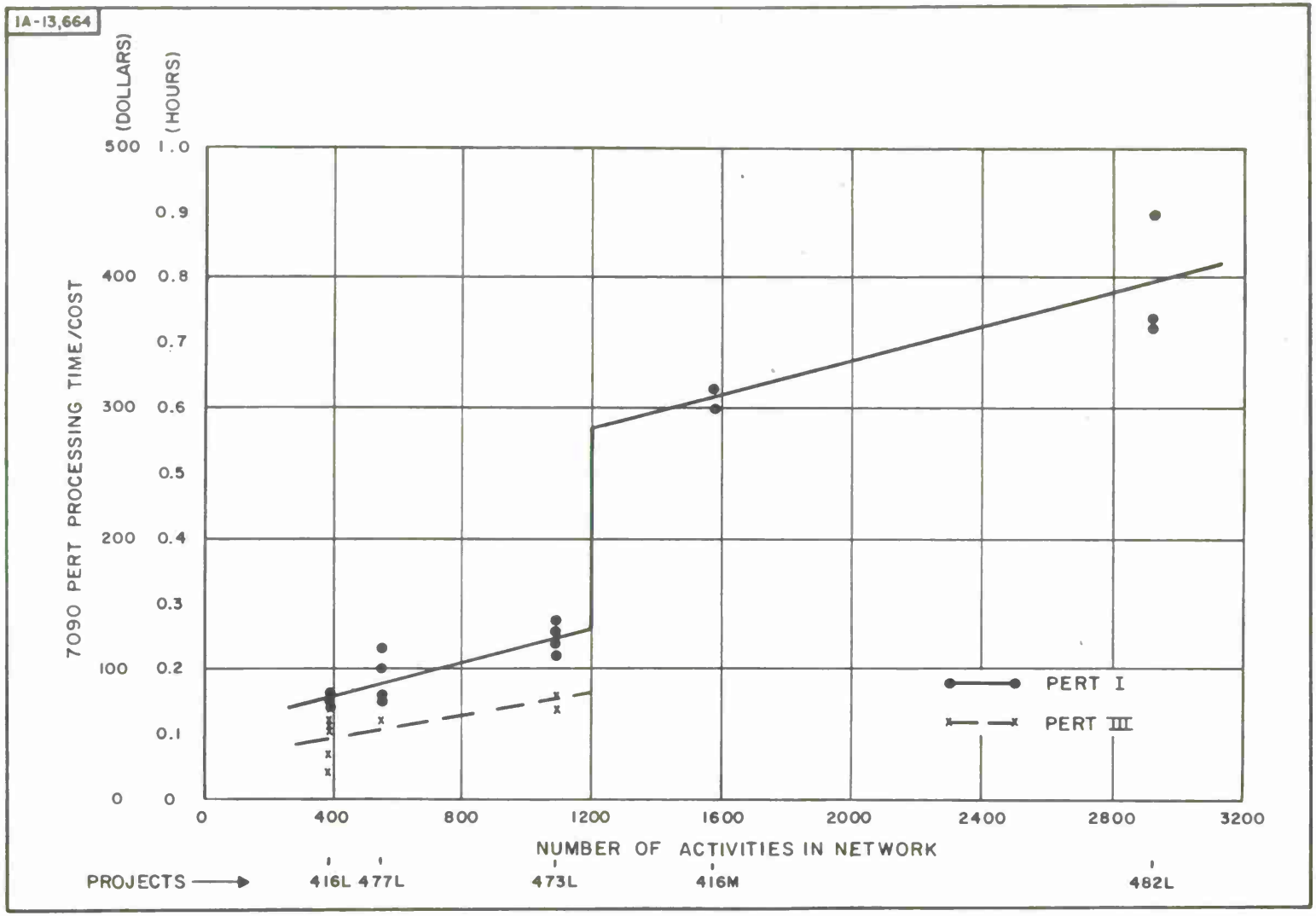

Fig. 1. Time (Cost) versus Number of Activities in Processing Single Runs of PERT Data on the 7090 Computer

MITRE 7090 facility to confirm this fact. Presuming this to be true, the PERT III program, in addition to its notable cost advantage over the PERT I program for networks numbering less than 1200 activities, should prove to be markedly superior to the PERT I program in the 1200-6000 region, assuming that the PERT III data can be reasonably extrapolated.

SECTION II

METHODOLOGY

Once the reason for the discontinuity was known, a straight-line relationship was noted as likely and then fitted by the least squares method, using only the data below 1200 activities. In the PERT I case, there was insufficient data above the 1200 activity threshold to do any formal curve fitting, and lacking any evidence to the contrary, a line parallel to the first stage was drawn. In the PERT III case, no data exist as yet above the 1200 threshold to validate its purportedly increased capacity.

The estimating equations, the accompanying correlation coefficient, and the standard error of estimate are shown on Exhibit I (Fig. 2).

EXHIBIT I

For PERT I Computer Program:

$$T_I = 0.106 + 0.000132\,A$$

where

T_I = elapsed computer time for PERT I, and

A = number of activities in PERT network.

Correlation coefficient, $r = 0.86$;

Standard error of estimate, $S_{y.x} = 0.0256$.

For PERT III Computer Program:

$$T_{III} = 0.054 + 0.000091\,A$$

$$r = 0.73$$

$$S_{y.x} = 0.0307$$

Fig. 2. Cost Estimating Relationships for Determining 7090 PERT Processing Times (Costs)

SECTION III

ASSUMPTIONS

(a) The processing costs indicated in this study are based upon a $500/hour rate for the 7090. Charges are applied on a proportionate basis, and as the workload varies during the year so does the rate. The rate for the 7090 facility at MITRE has varied between $485-$519/hour since August 1962.

(b) The above rate includes 7090 machine rental, the use of the 1401 for shredout and printout purposes, machine operators, and other overhead charges associated with the data-processing facility. The rate does not include costs of gathering or otherwise transmitting data to or from the facility; nor does it include key-punching costs. The latter task is more often done by the user than by the 7090 facility; hence, this cost is not included in the above rate nor depicted on Fig. 1. For information purposes, the cost of key punching varies from $0.02 - $0.03/activity, again depending on workload variations.

SECTION IV

FACTORS CONTRIBUTING TO VARIATIONS IN DATA

Variations in the data can be partially attributed to the following;

(a) The processing time is increased to the extent that the input cards are out of sequence. A presort according to the sequence of activities in the network minimizes this problem.

(b) The processing time varies according to the number and type of output listings desired.

(c) The elapsed time for processing a network is recorded manually by the 7090 operator and, therefore, contributes some error.

(d) The data was taken from a larger sample consisting of runs processed on both full program networks and subnetworks, neither of which was specifically identified as such. Judgment was used in selecting data to represent full program networks only.

SECTION V

SUMMARY

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